CORRESPONDENCE.

CONCERNING RIVETING.

TOKIO, Japan, Nov. 16, 1882.

EDITOR ENGINEERING NEWS:

If you will kindly allow me a little space in your paper, I would like to call attention to something which is greatly needed not only by students of engineering and young engineers, but also by many who have served for years in the profession—an exhaustive treatise upon riveting.

I have already referred incidentally to this matter in a paper on "A System of Designing Highway Bridges," which you saw fit to copy in your issue of March 25, 1882, and I would now urge upon some member of the profession, who has had considerable experience in this line of work, to undertake the task and confer a great favor upon all those who are not so well posted on the subject as himself.

To such a one I would make the following suggestions, and offer a very incomplete list of headings or topics, together with a few tables which I have prepared for my own use.

First, to write to all the principal bridge companies and iron works where riveting is done, and request of them their rules and all the information upon the subject which they would be willing to give, in order to obtain the practice of as many experts as possible. It is by no means certain that much information would be obtained in this way, for bridge companies seem to be somewhat chary about giving for nothing what has cost them both time and money to find out for themselves. This does not show a very good professional spirit; besides, it is a mistake to suppose that they would lose by giving information gratis, for it would improve the business of every first-class bridge company, if the standard of excellence in bridge construction were higher.

In regard to this conservative spirit I can speak from experience, for, having intended to work up the subject of "Dead Load in Bridges," and to ascertain, if possible, the effect of the different factors producing the dead load, reducing the same to some approximate laws, I sent around some blanks to the principal bridge companies to be filled out with the data required. The result was a lamentable failure; not a single blank was returned.

Second, to collect all that has ever been written upon the subject both directly and incidentally.

Finally, to combine the information thus obtained with the writer's personal experience, and make the treatment of the subject complete in every particular.

The topics referred to are these: spacing of rivets of different diameters, sizes of rivets for different thicknesses of plate, minimum distances from edges of rivet holes to edges of plates, same for angle irons, I beam flanges, T flanges, channel flanges, etc., sizes and weights of heads required for different rivets and the corresponding lengths, table of minimum spacings of rivet holes where there are several rows of staggered rivets, thus:

Dia.	1"	1⅛"	1¼"	1⅜"
½"				
⅝"				
¾"				
Etc.				

Rivet spacing in top chords, in splice and reinforcing plates, in lacing and latticing, in floor beams with parallel and inclined flanges, in tension joints, in boilers, etc.; hand riveting, machine riveting, comparison of the two, riveting tools, riveting machinery, method of preparing working drawings with a view to rapidity and ease in punching, countersinking and depth required for same for different diameters of rivets, field riveting, number of rivets that can be driven per day per man in shop and in field, number that can be driven by a machine, cost of the different kinds of riveting, criticism of Weyrauch's treatment of the subject in his work on "Structure of Iron and Steel," the uncertainty as to what portion of the total stress each rivet of a group takes up, effect of friction in reducing stresses upon rivets, wear and tear of rivets, comparison of pin connected and riveted girders, manner in which riveting may fail, etc.

Rivets, especially in bridge work, are usually figured for shear, but would they not give by bending rather than shearing, or is there some circumstance that would reduce the calculated bending moments?

As to whether the writer of such a paper as the one indicated would be repaid for his labor—pecuniarily, no; for technical papers seldom bring in enough profit to the authors to pay for even the time spent in writing—but indirectly, yes; in many respects.

In regard to publishing there would be no difficulty, for any of the engineering societies or periodicals would be glad to publish such a useful article.

I should be very happy to correspond with any one undertaking the paper, especially if I could be of any assistance. Yours very truly,

J. A. L. WADDELL,
Professor of Civil Engineering in the University of Tokio, Japan.

TABLE I.

Table of Working Shearing Stresses in Tons of 2,000 Pounds upon Rivets for Railroad and Highway Bridge.

Diameter.	Railroad.	Highway	Diameter.	Railroad.	Highway
½"	0.59	0.74	⅞"	1.80	2.25
⅝"	0.92	1.15	1"	2.36	2.95
¾"	1.93	1.66	1⅛"	2.98	3.73

TABLE II.

Table of Working Bending Moments in Inch-Tons on Rivets for Railroad and Highway Bridges.

Diameter.	Railroad.	Highway	Diameter.	Railroad.	Highway
½"	0.092	0.115	⅞"	0.403	0.616
⅝"	0.180	0.225	1"	0.736	0.920
¾"	0.311	0.380	1⅛"	1.038	1.298

TABLE III.

Table of Working Bearing Stresses of Rivets on Plates in Railroad Bridges.

Diameter.	3/16"	¼"	5/16"	⅜"	7/16"	½"	9/16"	⅝"	11/16"	¾"	13/16"	⅞"	15/16"	1"	1 1/16"	1⅛"	1 3/16"	1¼"
¼"	0.563	0.750	0.938	1.125	1.313	1.500	1.688	1.875										
⅜"	0.703	0.938	1.172	1.406	1.641	1.875	2.110	2.344	2.578	2.813								
½"	0.844	1.125	1.407	1.688	1.969	2.250	2.532	2.813	3.094	3.375	3.656	3.938						
⅝"	0.984	1.312	1.641	1.969	2.297	2.625	2.952	3.281	3.609	3.938	4.266	4.594	4.922	5.250				
¾"	1.125	1.500	1.875	2.250	2.625	3.000	3.376	3.750	4.125	4.500	4.875	5.250	5.625	6.000	6.375	6.750		
1⅛"	1.266	1.687	2.110	2.531	2.953	3.375	3.797	4.219	4.641	5.063	5.485	5.906	6.328	6.750	7.172	7.594	8.016	8.438

TABLE IV.

Table of Working Bearing Stresses of Rivets on Plates in Highway Bridges.

Diameter.	3/16"	¼"	5/16"	⅜"	7/16"	½"	9/16"	⅝"	11/16"	¾"	13/16"	⅞"	15/16"	1"	1 1/16"	1⅛"	1 3/16"	1¼"
¼"	0.704	0.938	1.172	1.406	1.641	1.875	2.110	2.344										
⅜"	0.879	1.172	1.465	1.758	2.051	2.344	2.638	2.930	3.223	3.516								
½"	1.055	1.406	1.759	2.110	2.461	2.813	3.165	3.516	3.868	4.219	4.570	4.923						
⅝"	1.230	1.640	2.051	2.461	2.871	3.281	3.691	4.101	4.511	4.921	5.331	5.742	6.153	6.562				
¾"	1.406	1.875	2.344	2.813	3.281	3.750	4.220	4.688	5.156	5.625	7.094	6.563	7.031	7.500	7.969	8.438		
1⅛"	1.583	2.109	2.638	3.164	3.691	4.219	4.748	5.274	5.801	6.328	6.856	7.383	7.910	8.438	8.965	9.493	10.020	10.548

N. B. The working stresses per square inch are as follows:

	Shearing.	Bearing.	Bending.
Railroad bridges	3.00 tons	7.500 tons	6.000 tons
Highway bridges	3.75 "	9.375 "	7.500 "

QUESTION IN PATENT LAW.

DEC. 21, 1882.

EDITOR ENGINEERING NEWS:

If a patent be issued on an article can that article be manufactured or made by a person for his own private use? Can it be made by a person for the use of his assistants in his own office? And can he employ an assistant to make the article for his own use and for that of other assistants in his own office, with no intention of selling or giving away the article without legally infringing on said patent? I.

[We have been informed that a patented article can be manufactured for individual use without its being an infringement. We do not know it for certain.—ED. ENG. NEWS].

ENGINEERS' BOOK OF TABLES.

NEW HAVEN, Conn., Dec. 25, 1882.

EDITOR ENGINEERING NEWS:

Will you please send me six copies of the West Shore tables. Enclosed find six dollars for same.

Yours truly, JOHN V. B. CLARKSON,
Room 57, 69 Church street, New Haven.

[This is Mr. Clarkson's second order.]

SHIP BUILDING—CORRECTION.

EDITOR ENGINEERING NEWS:

FERRYSBURG, Mich., Dec. 19, 1882.

In about the middle of the second paragraph of the middle column of page 427 you have, "Then is *B C* the actual working pitch corresponding to the width of the blade." It should be, "Then is *B G* the actual, etc."

Also, at the close of the paragraph your printer has given us "*B C*, too, has been called the full slip." It should be, "*D C*, too, has, etc.

In the first formula, same column, the printer has given us *main* pitch for *mean* pitch.

These are small things, but they turn into *chaff* the one small grain of wheat I had worked so long to bring out. H. C. PEARSONS.

BAD TASTE IN WATER.

LEE, Mass., Dec. 22, 1882.

EDITOR ENGINEERING NEWS:

SIR: Please advise through the NEWS, as to this:

After water has been turned off the street mains of our water service, when first turned on again it invariably runs white and milky, lasting for a day or so. After standing a few minutes it begins to clear itself from the bottom, having a sort of scum or froth on top.

We use cement-lined pipe; have 200 ft. head; pipes been in use a year. I give these details so that you may fully understand the situation.

An answer will greatly oblige

A SUBSCRIBER.

BRIDGE SEATS.

CHILLICOTHE, O., Dec. 20, 1882.

EDITOR ENGINEERING NEWS:

What is the rule or practice followed in determining the amount of seat to be given railway and highway bridges, of iron or wood, on the stone abutments and piers? C. B. C.

STEEL RAILS.

EDITOR ENGINEERING NEWS:

DETROIT, Dec. 26, 1882.

Can you tell me when steel rails were first brought into New York, where from, what price, and the duty paid? C. HURLBUT.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 437.)

CCCCXLVI.—CHATTANOOGA.

Chattanooga, Tennessee, in lat. 35° 3′ N. long. 85° 10′ W., is on limestone hills rising to 300 feet above the Tennessee River.

Settled in 1840, it was incorporated in 1850.

Water-works were begun by the U. S. army in 1864, were purchased by a private company which, after operating them a short time, failed, and they were bought by the Lookout Water Company, the present owners.

The supply is taken from the Tennessee River and pumped 175 ft. to a reservoir on the hill, 125 ft. above the business part of the city. It is in two compartments, respectively 125 and 160 ft. long and 150 ft. wide and 12 ft. deep, lined with brick on puddle. They are filled and emptied alternately to allow for settling the water. Pumping is by steam. The first pump was a "Woodward" of 18 in. steam and 9 in. water cylinder. In 1871 a duplex pump of same kind and size was added, in 1877 another duplex of 20 in. steam and 12 in. water cylinders, and in 1881 a Worthington or "Worthington" of 20 in. steam and 14 in. water cylinders of 30 in. stroke.

Distribution is by 15 miles of cast-iron pipe of from 12 to 4 in. diameter, with 58 fire hydrants, 55 gates and about 1,000 taps. The city pays $50 per year for each hydrant and also the municipal taxes on the company's property. Service pipes are of wrought-iron. There are no meters in use, as they have not proved available with the muddy water. For distribution one half mile of Wyckoff pipe was laid for trial, but has been removed.

The population in 1880 was 12,892. The daily average consumption is 1,000,000 gallons.

The capital stock of the company is $50,000. The works have cost $130,000. The bonded debt is $80,000 at 7 per cent. interest. No further financial statements are furnished.

A. M. Johnson is President and manager.

CCCCXLVII.—MEDIA, PA.

Media, Pennsylvania, in lat. 39° 55′ N., long. 75° 15′ W., is on rolling ground on Ridley Creek, 5 miles from the Delaware River.

It was settled and incorporated as a borough in 1850.

Water-works were built by the borough in 1870, after plans of Isaac F. Cassin, C. E., taking the supply from Ridley Creek, which has a water-shed of 12 square miles. A dam of rubble masonry, 150 ft. long and 10 ft. high, impounds the water and furnishes head to drive a turbine-wheel which works a pump of 300,000 gallons per day capacity. A Worthington duplex steam-pump of 500,000 gallons capacity was added in 1875. The water is pumped 274½ ft. to a reservoir of 1,500,000 gallons capacity, built in excavation and embankment, from 52 to 142 ft. above the town.

Distribution is by 6½ miles of cast-iron pipe, of from 12 to 4 in. diameter, with 25 fire hydrants, 36 gates and 385 taps.

The population in 1880 was 2,019. The daily consumption is 125,000 gallons.

The population is largely increased in summer by boarders and summer residents.

The works cost $65,000, which is the amount of the bonded debt at 4 per cent. interest. The expenses in 1881 was $1,200 and the receipts $4,028.

The works are managed by the Water Committee of the Borough Council. William Mancil is the Superintendent. Charles R. Williamson is Chairman of the Water Committee.

CCCCXLVIII.—ARLINGTON, MASS.

Arlington, Massachusetts, in lat. 42° 24′ 56″ N., long. 71° 9′ 34″ W., is on broken ground at the head of Mystic River.

Settled about 1735 it was incorporated as West Cambridge in 1807, and its name was changed in 1867.

Water-works were built by the town in 1872, after plans of W. A. Mason and C. D. Elliot, C. E., taking the supply from Lexington Great Meadows and North Brook, with a water-shed of 4½ square miles.

An earth dam with puddle heart, built across the valley at the mouth of North Brook forms a storage and distributing reservoir of 31 acres area and 10 ft. deep, holding 77,000,000 gallons at 117 ft. above the center of the town. The supply pipe to the town is of 12 in. wrought iron cement lined pipe. Distribution is by 14 miles of pipe from 12 to 4 in. diameter. That first laid was of cement-lined wrought-iron. Cast-iron is used for all extensions. There are 98 fire hydrants, 79 gates and 480 taps. The town contributes $1,000 per year for fire protection. Service pipes are of wrought-iron, cement-lined.

The bed of the reservoir was a peat meadow, and in 1876 the surface water in the reservoir was of unpleasant taste and odor, and a filter gallery was built near the reservoir, in porous ground, 135 ft. long, 12 ft. wide, with vertical side walls of stone, 4 ft. high, and arched over with brick. The bottom was 12 ft. below the surface of the ground. From one end a semicircular brick arch of 20 in. span, on timber flooring, extended 600 ft. From the end of this a 12-in. cast-iron pipe was laid to the supply pipe from the reservoir. In 1877 another gallery was built parallel to the first and inside the reservoir, being a brick culvert of 4 ft. span, each end of which was connected with the first gallery by drain pipe laid with open joints.

In 1880 the gallery was extended 100 ft. The soil is not very favorable for infiltration, and the yield is small.

In 1877 a brick conduit, 3 ft. in diameter, was built to divert water from the great meadows and Brown's brook to the reservoir.

The population in 1880 was 4,100. The daily consumption is not known.

The works had cost to Dec. 31, 1881, $433,636.59, and the receipts had been $85,610.43. The bonded debt is $300,000, at 5 and 6 per cent. interest.

The expenses in 1881 were $1,130.83, and the receipts $9,568.78.

The works are managed by three elected commissioners. Sylvester Stickney is the Superintendent.

CCCCXLIX.—SALEM, O.

Salem, Columbiana County, Ohio, is in lat. 40° 57′ N., long. 81° 55′ W.

Water-works were built as a private enterprise in 1862 by A. Philips, taking the supply from a spring and pumping it 45 ft. by a single-acting plunger pump of 6-in. bore and 12-in. stroke into a wooden tank holding 39,000 gallons, on a brick tower. In 1881 an artesian well was bored, and in May, 1882, a Worthington steam pump of 5¾ water and 6-in. steam cylinder was erected.

Distribution is by 4 miles of cast-iron pipe of 5 and 3 in. diameter, with 275 taps. There were some fire hydrants at one time, for which the town paid $500 per year, but now the supply for fire purposes is taken from cisterns for which the town pays $275 per year. Service pipes are of galvanized iron.

The consumption is not known. No financial statements are given. The works are now owned and operated by E. W. Silver.

CCCCL.—FROSTBURGH, MD.

Frostburgh, Maryland, in lat. 39° 40′ N., long. 78° 50′ W., is on a plateau between Savage and Dan's mountains, 1,792 ft. above sea level.

Water-works were built in 1855 by a private company, taking the supply from springs on the slope of Savage Mountain, 1 mile from the town. The water was conveyed from the springs to a stone reservoir 50 ft. square and 10 ft. deep, by 4-in. cast-iron pipes. In 1863 these pipes had become filled with rust, and were replaced by 6-in. pipes. There is a large wooden tank on the mountain side which affords sufficient head and storage for fire extinguishing without the use of fire engines.

Distribution is by 3½ miles of cast-iron pipe of 8 to 4 in. diameter. In 1874 the 4-in. pipe originally laid in the main streets were found insufficient, and were replaced by larger sizes. There are 20 fire hydrants, 15 gates and 180 taps.

The daily consumption is 23,000 gallons.

The first works cost $10,000. The expenses in 1882 were $350, and the receipts $1,700

William O. Sprigg is the manager.

TO BE CONTINUED.

The receipt of statistics as follows is acknowledged with thanks: From Isaac S. Cassin, C. E., statistics of Media, Pa., water-works. From E. W. Silver, proprietor, statistics of Salem, Ohio, water-works. From Robert Weir, Water Commissioner, history of Cohoes, N. Y., water-works. From George I. Wilber, Vice-President, statistics and water rates of Oneonta, N. Y., water-works. From F. W. Hodgson, Asst. Eng. Harbor and Land Commissioners, Boston, statistics of Arlington, Mass., water-works and reports 1874 to 1881. From W. O. Sprigg, Superintendent, statistics of Frostburgh, Md., water-works. From Luther Hill, President, statistics of Spencer, Mass., water-works. From Robert Surtees, City Engineer of Ottawa, statistics of water-works of Peterborough, Ont. From E. Mather, statistics of water-works of Decorah, Iowa, and report. From John C. Chase, Supt. and Engr, Clarendon Water-works Co., statistics and water rates of water-works of Wilmington, N. C.

TO WATER-WORKS OFFICIALS.

With the close of this volume of ENGINEERING NEWS "The History and Statistics of American Water-works," which has been in course of publication in our columns weekly since March 1881, comprises historical sketches and the fullest information attainable of the water-works of 450 cities and towns. No such collection of statistics of water supply has ever been made anywhere before. But the work is still incomplete. There are three hundred more towns in the United States and Canada which have public water supplies. Every one of them has been applied to, two, three and four times, to furnish the desired information. From some it has been promised, but from many no response has yet been had. *The information must and will be obtained*, and somebody or other will be persistently urged for it, until a response is obtained. One of the best descriptions recently procured, was accompanied by a note from the president of the Water Company saying, "your persistency has overcome my obstinacy," and so it will be in other cases. The work is of too much value to be abandoned half way, and we are sure that too much interest is felt in it by the great majority of the persons who manage and build water-works, to permit it to be stopped. The author of the work and the editor of this paper are in almost daily receipts of letters of inquiry regarding the completion of the work, and speaking of it in terms of high appreciation.

To satisfy, as far as practicable at present, the desire for some comprehensive and practically useful statement of the results already obtained Mr. Croes is now preparing and we will issue about Jan. 31 a table of the principal statistics of all the water-works from which replies have been received. This will be in pamphlet form and will be given away to all our subscribers and to the officers of the works. The issue of the completed book, "The History and Statistics of American Water-Works," we hope to be able to announce some time during the year 1883. To effect this we must have the co-operation of all who are interested in the subject. The author must be furnished with the data required, from the towns which have not responded. Of the 65 cities of over 30,000 inhabitants only Reading, Pa., and Mobile, Ala., have made no reply. The Controller of Reading has kindly sent financial statements, but four separate appeals to the officers of the water-works and two letters to private individuals who promised to give assistance have been unable to get a single figure. Is it possible that the Reading authorities know nothing about the history and condition of their own works?

Then of the 100 next largest cities in the country only Bridgeport, Conn., San Antonio, Texas, Haverhill, Mass., Norwalk, Conn., and Brockton, Mass., neglect to answer. The list can be extended to smaller towns, but it is hardly worth while to do so here and now. We propose to get the information anyhow, and if our friends will help us it will save trouble and facilitate the completion of Mr. Croes' invaluable book.

THE ORGANIZATION of the Pittsburg, Akron & Chicago railroad has been perfected. The proposed road is to run west from Youngstown through Akron to the west line of Media County, intersecting with the Cleveland, Delphos and St. Louis Railroad. It is now proposed to build, equip and have in running order this seventy miles of road by January, 1884.

FOREIGN NOTES.

AN UNDERGROUND ELECTRIC RAILWAY.

The first electric railway in a mine is that in the Royal Saxon collieries near Zauckerode. It has just been opened, and is said to work excellently. The electric mine railway serves for transporting coal in a transverse heading of the 250-meter level. The locomotive, only 2 ft. 7 in. broad, weighs, according to *Glaser's Annalen*, 1,500 kilogrammes (about 1½ tons), and moves ten trucks weighing, loaded, 10 tons each at a rate of 10 ft. per second. The transmission of power is not effected by a center rail, but by a small contact carriage provided with brushes, running upon T-shaped iron rails, which is fixed, isolated, to the roof of the heading. The railway is at work from 4 a. m. to 11 p. m. Judging by the experiences of the Paris electric railways, it may be advisable to let the contact carriage run along a pipe instead of rails, to prevent its derailment. We hear that the Berlin West-end Electric Railway is being reconstructed on this principle.

IMPORTANT INVENTION IN THE METAL TRADE.

An invention which it is believed will effect important changes in the metal, and not only in this country but throughout the world, has been made by a Birmingham metal manufacturer, after thirty years of constant experiments, in which he has expended over 30,000*l*. The invention has just been patented in Great Britain, France, Germany, Russia, Austria, Belgium, Sweden, Italy, Spain, the United States, Canada, and India. It consists of a new process of making alumina, from which aluminum can be manufactured at about one-tenth the cost by ordinary methods; and as aluminum is recognized as the most valuable metal for forming workable alloys, the importance of the discovery cannot be overestimated. This, indeed is shown by the fact that companies in France have just offered upwards of a quarter of a million sterling for the patent right for that country alone, while the aggregate offers of American, German, Belgian and other companies amount to more than a million of pounds. The inventor is Mr. James Webster, of Hollywood, who has organized a company under the style of the Aluminum Crown Metal Works Company (Limited), seven proprietors to work the patent. Under the ordinary process alumina costs 1,000*l* a ton, whereas by Mr. Webster's process it is less than 100*l*, besides which all the bye products are utilised, and from these a blue dye is made, which, it is believed, will supersede indigo for calico printing, inasmuch as it permanently retains its color, and is not affected by acids. Mr. Webster's alumina deposit is certified by an eminent analyst to contain 84 per cent. of pure alumina as compared with 65 per cent. realized by the ordinary process, and the oxide can now be made in any quantity in the course of a few days, while hitherto it could only be produced in limited quantities, and the process required nearly nine months. At present, Mr. Webster is the sole maker of alumina in England, prior attempts to introduce the manufacture into this country having involved the promoters in immense losses, which compelled them to abandon it, and consequently the French have had the entire monopoly of the trade. Owing, however, to the expense of production, and the limited quantities of the metal produced, aluminum has hitherto only been used for small ornaments of jewelry, musical and mathematical instruments, the castings of machinery, etc., but it can now be used in combination with other metals for multitudinous purposes. Many tons of bismuth-bronze, manufactured for the aluminum, have been sent to Hull for conversion into steam propellers for the Eastern Steamship Company, the advantage claimed for the bronze being that it has nearly one hundred more resisting power than any other material used for the purpose, while in the event of a collision it will bend rather than break, and further, it will not corrode from the action of the salt water. It is also used for ship fittings, and is rolled into sheets for all kinds of purposes for which electro-plating is now applied, spoons, knives and forks, dish covers, railway carriage and tool handles, and other articles being made from it by a leading Sheffield firm. Aluminum bronze is also made which is adapted for the manufacture of artillery, and several consignments have been made to the Royal Gun Factory at Woolwich by order of the War Office. The metal has a straining power of 42 tons to the inch, as against 28 of gun metal. The bronzes is also converted into wire for electric telegraph purposes, and is being introduced for Post-office purposes in London; while samples are now being tested in Glasgow for similar purposes. Among the numerous other purposes to which the metal is being applied are for bell making, piano-forte wire making and the manufacture of jewel rings and other jewelry, which are in demand for the United States.

THE SIRHIND CANAL.

This great public work was opened with all due ceremony at Bombay, India, on the 10th ult., by the Viceroy. The Sirhind canal was first projected in 1840, for the purpose of utilizing the waters of the Sutlej, for irrigation purposes. Its total length is 502 statute miles, and when all the irrigation works are completed 2,500 miles of channel will have to be maintained. It is designed to irrigate 522,000 acres in British, and 261,000 acres in native states. The total cost was 407 lakhs, of which 278 lakhs were paid by the British Government, and 129 lakhs by the native states. It is the second large work of the kind undertaken in the Punjab since it has come under British rule. The management of the internal distribution of the water is left to the village communities, through whose territory the canals and branches pass, Government only interfering to prevent wilful waste. Col. Home of the Royal Engineers is in charge of the construction.

TURKISH PUBLIC WORKS.

The foliowing official notice was published Dec. 5:

"Among the committees of reform recently instituted by Imperial decree, that concerning the study of the amendment to be introduced into the system of public works, for the progress and development of agriculture, commerce, and industry, has concluded the framing of by-laws to be adopted in conventions, and terms for conventions, rules for companies and the law of expropriation —all of which have been submitted to the Sublime Porte. These by-laws, which determine the bases and the conditions on which the Imperial Government will grant concessions for railways and roads, the establishment of harbors and canals, the draining of marshes, the navigating of rivers, etc., have been approved by the council of Ministers, and sanctioned by His Majesty the Sultan, who has been pleased to order that they be carried out in conformity with the Imperial decree."

The Ministry of Public Works having been authorized to proceed with the necessary formalities for granting concessions, the present notice is to give information to capitalists. The by-laws above referred to will be immediately published.

THE ENGLISH CHANNEL TUNNEL.

M. Léon Say in reply to a deputation of English Trades Unionists who waited on him on the 30th ult., said "that he had from the outset been one of the promoters of the tunnel, having been associated with the efforts of the late M. Michel Chevalier, and the more recent experiments had proved that its construction was perfectly feasible, and even easy. From a technical standpoint, therefore, success was certain. Economically, its utility could not be questioned on either side. It would make certain French Departments the market gardens of England, while France would reap the great advantage of being in closer relation with the supply of English manufactures. As to the military questions, it would not be becoming for Frenchmen to discuss them. They could only wait till public opinion in England was ripe. It was not for them to urge on England the parting with any of what she deemed her defences. This was a question solely for the English themselves. It was originally thought that an Anglo-French company would be best, but the different laws of the two countries as regarded public companies rendered it necessary to split the enterprise in two, and to create two distinct companies. The French company was a permanent one, and was quite ready to commence definitive operations as soon as England opened her door. It had not at present suspended boring—experiments were being made as to the probable cost. Thanks to these experiments, it was now certain that the outlay would not be so great as was at first anticipated. Beaumont's, and other English machinery were being used, and it was now almost certain that the tunnel could be constructed in five years. So much easier, indeed, had the work been found than was expected, that it was within a possibility of being completed in four, or even three years. It was important that its English advocates should show how greatly commercial interests would be benefitted by the scheme, while there could be no doubt as to the existence of a friendly feeling; to which Mr. Shipton, who brought over English aid to the distressed agriculturists of France after the war, could bear testimony. For the preservation of peace, friendly relations were more effective than fortifications. Many persons on this side of the Channel hoped the tunnel would soon be an accomplished fact; but it was not for them to take part in any movement for controverting the English military authorities. M. Say remarked that every precaution was taken by the French Government before submitting to the Chamber a Bill sanctioning the tunnel. It took care to ascertain that the English Government of the day were favorable to the scheme, and also that the representatives of the Opposition approved it.

The delegates then called on M. de Freycinet, when M. Adolphe Smith acted as interpreter on both sides—which duty he has fulfilled with admirable skill throughout the visit. Mr. Shipton explained that the object of the call was to offer a recognition of M. de Freycinet's eminent service in sanitary matters, both to London and other towns in England, by his treatises. Sanitary measures had always been regarded by the working classes as one of the best means of educating the masses. With sound, healthy bodies they would have sound minds, and nobody with a healthy mind would be an advocate of war. The Unionists also supported the tunnel, as tending to render war impossible.

M. de Freycinet, in reply, said he felt highly honored by the reference made to his works on hygiene. During his stay in England he visited a large number of factories, and he brought back with him the highest conception of England's power. It was at Liverpool and such ports rather than at Aldershot that he learned to admire the English people; and this experience led him to be a steady advocate of an alliance between the two countries. As a mining engineer, he has studied more particularly the geological phase of the tunnel scheme, and nobody was more delighted than himself at the discovery that it was practicable. He looked on the tunnel as a route, not for invasion, but for friendships, and as an additional link in the union between the two countries, which would help to dispel all military fears. These apprehensions would not stand the test of criticism. Even were England invaded, it could never be conquered or annexed. There were too much vitality and energy in the English for such a thing to be possible. The national feeling of the English people would raise a rampart which no power could overthrow. They would rise as one man. A slight protection at the mouth of the tunnel would render aggression impossible; and even if an invasion were ever effected, it would be by ships, whether the tunnel existed or not. He trusted that the enterprise would be persevered in, for the greatest advantages would accrue from such facilities of intercourse, and the study of each other's customs and habits. Frenchmen who, like himself, visited England, always returned with a feeling of enthusiasm, inspired by the contemplation of the industrial greatness and political freedom enjoyed by her people. It was the example he there saw that induced him to defend the cause of liberty in France, and he only wished the Continent enjoyed as much freedom as England. In England the working classes were wise enough to discard Utopian ideas, and confine their action within the limits of legality; while, on the other hand, the upper classes were sensible of the spirit of the times, and acceded to just demands. Had the same spirit of compromise existed in France many revolutions would have been avoided. From a commercial, political and social standpoint, therefore, Frencemen were justified in desiring the tunnel, and its construction would be one of the greatest achievements of the 19th century."

THE WATER SUPPLY OF EDINBURGH.

This was the subject of a paper read before a recent meeting of the Royal Scottish Society of Arts, in Edinburgh, by Mr. Alexander Leslie, M. I. C. E., etc. The author, after stating that the city is now in possession of a supply of water inferior to none in quantity, quality and cheapness, gave some particulars regarding the history of the water supply of Edinburgh, from the inauguration of the first gravitation supply in 1681, before which time Edinburgh had to rely on wells. He also detailed the parliamentary proceedings which led up to the appropriation of the present supply from Moorfoot. Going on to describe in detail the various Moorfoot works, he mentioned that the area occupied by Gladhouse reservoir was 390 acres, and that it was capable of containing 1,700 million gallons, while Portmore had an available capacity for 250 million gallons. It was estimated, he said, that when the whole of the works were completed there would be an available supply of 17 million gallons per day, or double what the maximum supply was before the Moorfoot water was introduced. Alluding to a prophecy that had been made, to the effect that the presence of large accumulations of water in the various districts would be damaging to the surrounding properties, by causing cold, damp winds, he stated that this view had been found to be erroneous; and that the farmers were of opinion that the land was benefited by the presence of the water, inasmuch as they found that the frost was much less intense than formerly. —*Contract Journal.*

TRACK-LAYING is going on at the rate of half a mile a day on the western end of the Utah extension of the Denver & Rio Grande Railroad. It is expected that the line will be completed to Salt Lake by March 1, and that it will reach Ogden a month later. Ninety-eight miles of rails remain to be laid on the eastern end of the line, and twenty miles on the western end.

ENGINEERING NEWS

AND

AMERICAN CONTRACT JOURNAL.

Tribune Building, New York City.

GEO. H. FROST.....EDITOR AND PROPRIETOR.
S. D. V. BURR, A. M. ....ASSOCIATE EDITOR.

SATURDAY, DECEMBER 30, 1882.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

Terms of Advertising.—One inch, 12 lines, one insertion, $2; one month, $6.50; three months, $17; six months $30; one year, $50. Special rate for large space and long time will be given on application. Advertisements inserted for less than three months, payable in advance; for longer time, payable quarterly.

Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

CLUBBING ARRANGEMENTS.

1883.

In order to accomodate such of our subscribers as may wish to subscribe for other periodicals we offer the following terms: We will send to any address ENGINEERING NEWS at regular subscription price, $4.00, and the following at the additional prices given:

	Net Price.	Reg. Price.
Atlantic Monthly	$3.25	$4.00
Century Magazine	3.55	4.00
Harper's Magazine	3.25	4.00
Harper's Weekly	3.25	4.00
Harper's Bazar	3.25	4.00
Harper's Young People (weekly)	1.25	1.50
St. Nicholas Magazine	2.55	3.00
North American Review	4.00	5.00
Our Continent	3.25	4.00

The principal change in the above figures from those of last season is in that of the *Century Magazine*, which has advanced its trade price correspondingly. Our purpose is to bring the trade of our subscribers into this office, and to do his we give the clubbing journals at trade price and we add five cents to pay for stamps, stationery and time in handling the business. We wish it understood that we will extend this arrangement to any desired journal in the United States, so that our subscribers need not pay any attention to the claims of solicitors, who cannot offer any better terms.

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NOTICE OF MEETINGS.

AMERICAN SOCIETY OF CIVIL ENGINEERS, 127 East Twenty-third street, New York. The thirtieth annual meeting of the society will be held in New York, on Wednesday, Jan. 17, 1883, at 10 A. M. The annual reports will be presented, officers for the ensuing year elected, time and place for the next annual convention considered, proposed amendments to the constitution discussed, and other business transacted. Arrangements for Jan. 17 and 18 will be perfected by a committee, and you are invited to be present at the meetings on those days.

THE OHIO STATE ASSOCIATION OF SURVEYORS AND ENGINEERS.—The third annual meeting of the above Association will be held in Columbus, Ohio, on Jan. 17, 18, 19, 1883. There is every reason to believe that there will be a very full attendance of the surveyors and engineers of the State, and that the meeting will be of great interest and value. Parties expecting to attend the meeting will do well to notify early the Secretary, Benjamin Thompson, Urbana, Ohio.

COUNTY SURVEYORS' ASSOCIATION OF INDIANA.—The annual meeting of the association will be held at the County Surveyor's office, in the Court House, at Indianapolis, beginning on the 16th of January, 1883. Addresses on different subjects in regard to surveys, ditches and gravel roads are expected to be delivered, which will be of interest to the Indiana surveyers. An interesting meeting is expected.

HERVEY B. FATOUT,
Corresponding Sec'y.

THE MICHIGAN ASSOCIATION OF SURVEYORS AND ENGINEERS. The Fourth annual meeting of the above association will be held at the State Capital, Lansing, Michigan, on January 9-12, 1883.

PROGRAMME.

TUESDAY, JAN. 9.—2. P. M.

Association called to order. Reading of minutes. Committee to examine surveyors' instruments appointed.

3 P. M.

Legislative needs of our profession.—Paper by George E. Steele, Grand Traverse. General discussion.

7.30 P. M.

Address of President, Prof. C. E. Greene of Ann Arbor. General discussion.

Construction and care of our common roads; by Burton Kent of Adrian. General discussion.

WEDNESDAY, JAN. 10.—9 A. M.

Difficulties in city surveying.—A. J. Teed, City Engineer, Cadillac. Discussion.

Construction and care of water-works suitable for small cities in Michigan.—Chas. B. Hyde, City Engineer, Jackson.

2 P. M.

Method of projecting parallels of latitude.—H. C Pearsons, U. S. Inspector of Steam Vessels, Ferrysburg. Discussion.

Questions in practice.—I. H. Leavenworth, Engineer, Saginaw City. Discussion.

7.30 P. M.

Surveying instruments.—Prof. J. B. Davis, Ann Arbor. Remarks by manufacturers and others.

Report of Committee on Instrument Exhibit.

THURSDAY, JAN. 11.—9 A. M.

Reports of committees.—The manual; legislation. Discussion.

Railroading in Utah.—Frank Hodgman, Engineer, Climax Discussion.

2 P. M.

Construction and operation of narrow-gauge railroads.—A. L. Reed, Chief Engineer P. H. & N.W. R. R., Port Huron, Mich. Discussion.

Logging railroads of Michigan.—E. F. Guild, Engineer, East Saginaw, Mich. Discussion.

7.30 P. M

Traverse surveying.—Prof. J. B. Davis, Ann Arbor, Mich.

Engineering of town and county drains.—S. N. Beden, Engineer, Pine Run.

QUESTIONS OF PRACTICE.

In order to avoid waste of time it is important that such questions be arranged and given some consideration before our next meeting. Mr. I. H. Leavenworth, of Saginaw City has kindly undertaken this task. It is to be hoped that enough queries will be submitted to cover most of the difficult points in practice. Questions on which the opinion of the Association is desired should be sent at once to Mr. Leavenworth or the Secretary.

EXHIBIT OF SURVEYING INSTRUMENTS.

By a special vote of the members at the last meeting an exhibit of surveying instruments will be held at our coming meeting. We invite each member to exhibit his instrument of practice, whether good or poor, and shall provide proper place for such an exhibit. We especially invite manufacturers to exhibit instruments of their own make. If they can attend our meeting personally, we offer them a place on our programme. To our members we will say that we hope to induce one or two of the most noted manufacturers to be present with us.

ENTERTAINMENTS.

The hotels in Lansing will give the following rates to members of the Association:

Lansing House	$2.00 per day.
Hudson House	2.00 "
Chapman House	1.25 "
Goodrich House	1.25 "
Everett House	1.00 "

INDUCEMENTS TO ATTEND.

Each member of the association should arrange his work so that he can be in attendance throughout the whole meeting. The advantages to be attained may be stated briefly as follows: Mutual instruction, which in time will be evident in a more uniform practice; acquaintance and good feeling toward fellow laborers, which cannot be estimated in money; an opportunity, at small expense, to see the attractions of the State capital during a session of the Legislature.

Surveyors or engineers, not members, should embrace this opportunity for joining the association.

PROF. H. C. CARPENTER, Lansing, Mich., Secretary.

THE PANAMA CANAL.—Yesterday we were informed at the office of the Franco-American Trading Company that they had closed the largest contract yet given for work on the Canal. The contract extends over 16 kilometers, commencing at Panama, and the amount to be excavated is from 8 to 10 millions of cubic meters. The machinery for doing this work will, probably, be obtained from the Pound Manufacturing Company, of Lockport, N. Y.

AMERICAN SOCIETY OF CIVIL ENGINEERS.

Mr. Wm. P. Shinn, M. Am. Soc. C. E., read a paper on the "Increased Efficiency of Railways for the Transportation of Freight," at the regular meeting of the society on the 20th. We present the following abstract: The first portion of the paper gave from carefully gathered statistics, a valuable amount of information in regard to the actual increase of traffic upon American railways. In 1860 the tonnage mileage of the New York Central & Hudson River Railroad, the Erie Railway and the Pennsylvania Railroad was about equal, and amounted in the aggregate to a little over three-fourths of that of the New York State canals, and in 1870 each of these railroads averaged about the tonnage of the canals; and in 1880 they averaged each nearly double that of the canals.

The aggregate tonnage mileage of the other railroads was, in 1881, 1217 per cent. more than 1860. Statistics were also given showing the increase of population, of railroad mileage, of the production and export of grain and other leading exports. The means by which this rapid increase of freight transportation had been developed was considered under two general heads, namely, improvements in the physical conditions of the railroads, and improvements in the administration. The improvements in the physical condition were treated on under these heads:

1. Improved track or "permanent way," including bridge structure.
2. Additional sidings and second, third and fourth tracks.
3. Increased capacity and strict classification of locomotives.
4. Increased capacity of freight cars.
5. Additions to terminal facilities.

The improvements in the administration were referred to under the following heads:

6. Improved methods of signaling.
7. Running locomotives "first in, first out," and running freight trains at higher rates of speed.
8. Consolidation of connecting lines under one management by purchase, lease, amalgamation or otherwise.
9. Running freight cars through from point of production to tide water without transshipment.
10. Issuing through bills of lading (or freight contracts) from Western points of shipment to Atlantic and European ports.

The general introduction of steel rails was stated to be the very corner-stone of increased efficiency. The improvements in all the directions referred to were treated of and described at considerable length.

The second portion of the paper presented the writer as to the means whereby still greater efficiency could be most economically obtained. The constant demand is for more transportation facilities, for more cars. In the opinion of the writer what is needed is not so much more cars as movement of cars. Freight blockades will be prevented, not by having more tracks to stand cars upon, but by having fewer standing cars. It was shown that upon one railway there had been a decrease in the miles run by the cars of 21 per cent. between 1868 and 1881, and that the Union Line cars between 1879 and 1882 were increased 49 per cent., while the mileage run by them decreased 16 per cent. in the same period. The remedies suggested by Mr. Shinn were: More main tracks, more locomotives, more trains, the improvement of the making up of trains at the points where cars are loaded. The detention of cars at stations and private sidings and the absence of cars on foreign railroads were considered as among the greatest causes of loss, and the writer suggests that the remedy will be to charge a per diem charge for cars when on foreign roads, and that this charge should be based upon the average economic value of the cars in use to their owners.

The paper was discussed by Messrs. T. C. Clarke, G. S. Greene, Jr., W. C. Andrews, C. Macdonald, C. E. Emery, and by the author.

By a vote of the Society it was directed that this paper should be discussed at the annual meeting. Members of the Society and others interested in this subject are requested to contribute to this discussion. The annual meeting of the Society will occur January 17 and 18, at the Society house in New York. The first session of the meeting will be at 10 a. m., January 17, 1883.

PERSONAL.

F. C. HAND has been appointed superintendent of the San Pete Valley Railroad and Central Pacific Coal & Coke Company, vice F. S. CAHILL, resigned. Headquarters at Wales, Utah.

Professor ROBERT FLETCHER, of the Thayer School of Civil Engineering in Dartmouth College, and the students of that department, started Tuesday on their annual tour of inspection of public works, visiting first Boston, Watertown, Lowell and Lawrence.

Mr. WILLIAM LUSH, resident Civil Engineer, has been appointed Assistant Chief Engineer of the New York Central & Hudson River Railroad, with headquarters in this city. Mr. GOULD, an assistant of Mr. LUSH, takes the place made vacant by the latter's promotion.

MR. GRAHAM SMITH, C. E., who last January was appointed Port Engineer; Rangoon, has resigned that appointment, stating as his reason that the Commissioners will not supply him with the necessary ways and means to perform his duties. The Port Commissioners have, however, declined to accept the resignation, and have requested him to complete the agreement with them for five years.—*Calcutta Englishman, Nov.* 8.

MR. D. BONTECOU, Mem. A. Soc. C. E., of the firm of KNIGHT & BONTECOU, Civil Engineers, Kansas City, Mo., is spending the holiday season at his old home in this city. Mr. BONTECOU was formerly connected with the Park Department of New York, but in 1880 opened an office in Kansas City for general engineering business. The firm has been very successful. Mr. KNIGHT is City Engineer of the most enterprising city west of the Mississippi; and Messrs. KNIGHT and BONTECOU are engineers for several enterprises, among which may be mentioned the Kaw Railroad Bridge, the Kansas City Belt Railway, the Inter-State Fair Association, Union Depot Company, and the Kaw Valley Town Site and Bridge Co.

VIBRATIONS IN BRIDGES.

Prof. S. W. Robinson in a report, included in the forthcoming report of the Ohio Railroad Commissioners, submits the following very interesting remarks on cumulative vibration in bridges:

It is a well-known physical fact that rhythmical impulses, though very slight individually, will result in an astonishing cumulative action when applied for a time to a body so circumstanced as to vibrate in equal rhythm. Soldiers in marching must break step in passing over foot bridges, else, if the bridge should have a time of vibration equal to the time of step, the structure would vibrate seriously. The trot of a dog has been observed to cause a street bridge to vibrate with decided intensity, the vibration being observed to keep time with the dog. Horses in vehicles "must not move over the bridge faster than a walk," for fear the trot and vibration periods shall agree. The child in a swing is able to rise from a low to a high attitude without help, simply by a tilting motion of the body, so directed that each adds a slight impulse to the oscillatory movement. Similarly in railroad bridges a slight want of perfect balance of the locomotive driving-wheels may cause unexpected vibrations and unanticipated strains when the times of half revolution of drivers harmonize with the bridge vibration time. The likelihood of such synchronism may be rendered more apparent by means of calculated results. For example, a train moving at the rate of 30 miles per hour has a velocity of 44 ft. per second. Locomotive drivers of 5½ ft. diameter make one revolution in about 0.4 second, or a half revolution in 0.2 second.

Now, an iron bridge of 150 ft. span will weigh about 1,400 lbs. per foot. In vibrating vertically, as by placing a heavy load upon it suddenly, the ends at abutment do not participate, while the middle is most active. To get an approximation, without going into refinements as to distributed masses, suppose half the bridge length to vibrate equally while the quarters near the abutments do not vibrate, then half the weight of the bridge will enter into account for vibration, or 105,000 lbs. Next, let us suppose a train moves rapidly on in which the drivers are out of balance; if the bridge vibrates, the engine and train to abutment will vibrate with it, so that a portion of vibratory mass must be added. Taking the weight of the train at 2,000 lbs. per foot, the half span, or 75 ft., will weigh 150,000 lbs. Finally, let it be supposed that the static deflection of the bridge for this train-load is 1 in., which is about that found for such cases. Now, by the principles of dynamics, the time of vibration for this case, supposing the load at the center of bridge, is found to be

$$t = \pi \sqrt{\frac{W d}{w g}}$$

Where W is the total load, 105,000+150,000 = 255,000 lbs., w the added load = 150,000 lbs., d = the static deflection, = 1 in., or $\frac{1}{12}$th ft., and g = the acceleration of gravity = 32, nearly. Introducing these and reducing we find the time of a simple vibration to be 0.2 second, a value which agrees with the time of revolution of the drive-wheels. Hence, unbalanced drivers will here cause vibration, with a period of 0.2 second. The period from the highest point back to that point of movement will correspond to the entire revolution, or 0.4 second of time. This will cause 2½ complete movements per second and is the period which would be noticed by an observer.

Similarly, a bridge of 300 ft. span weighing 2,000 lbs. per foot, undergoing a static deflection of 2 in. from a freight-train load of 2,000 lbs. per foot will vibrate in a period of 0.35 second. A double vibration, which corresponds with the time of revolution of a drive wheel, would be made in 0.7 second. This time of revolution of 4-ft. drivers answers to a train speed of about 11½ miles per hour or 14½ for 5-ft. drivers. This case answers fairly to freight trains. Hence, it appears that bridges are liable to become badly shaken from cumulative impulses, those of 100 to 200 ft. span by passenger trains and those of 200 to 400 ft. span by freight trains. To estimate the amount or intensity of this action, first consider passenger trains. To this end we will take advantage of the calculations of Mr. J. W. Cloud, of Altoona, Pa., Engineer of Tests for the Pennsylvania Railroad. The results of his calculations are given in a valuable paper, evidently prepared with much care, on "Shocks on Railway Bridges," and read before the American Institute of Mining Engineers, February, 1881. His calculations are for a locomotive of the Pennsylvania Railroad, Class B, the weight of which in running order is 73,100 lbs. Drive-wheels, four in all, are 62 in. in diameter; weight of tender, loaded, 49,800 lbs.

The shocks that Mr. Cloud calculates are those due to the centrifugal force of the counterbalance weights in the drive-wheels, and considered as acting upon the bridge like a hammer with repeated blows, but without supposing synchronous bridge vibration to follow. These calculations, as far as the downward and upward thrusts from centrifugal force are concerned, are exactly to our purpose. At a speed of 50 miles per hour, these thrusts for each of the four wheels are given at 6,260 lbs., and act downward when the counterweight is down, and upward when the counterweight is up, the two being repeated 4¼ times every second. For our present purpose we must find the effect of all the wheels on the bridge, supposing the latter to vibrate in synchronism.

Now, as the wheel revolves, the centrifugal force acts in the direction of a radius through the counterweight, but this radius revolves with the wheel. For a half revolution there is a component downward, and for the other half there is a component upward. The resultant effect for a half revolution is about the same as though two-thirds of the force acted constantly for the half revolution downward, and then for a half revolution upward. Hence, for a single wheel the two-thirds of 6,260 is 4,173 pounds. Now, to include the effect of the four wheels, it appears, from the fact that opposite wheels have cranks at right angles, the resultant of forces in a right angled triangle should be taken for each pair of wheels, giving $1.42 \times 4.173 \times$ by 2 pounds = 11,851 pounds for the combined action of all the wheels, in the form of a constant force for a half revolution. This is equivalent in its effect upon the bridge to that of all the counterweights. Now, it is well known by the principle of dynamics that the dynamic deflection due to this force is twice the statical. The latter can be found by simple proportion, in a comparison of the 11,851 lbs. with the train-load of 150,000. If the latter produces a deflection of 1 in., the former will cause a statical deflection of 0.079 in., which will be downward for the downward force, and *vice versa*. Calling these points of static deflection neutral points, we have for cumulative synchronous vibration the first dynamic downward deflection, equal to $2 \times 0.079 = 0.158$ in., with the lower neutral point at the middle of the amplitude. Now, because the force is reversed, the return amplitude will be such that the upper neutral point divides it equally, from which it appears (by aid of a sketch) that the latter amplitude is three times the first. The next amplitude, downward, with lower neutra point central, will be such as to reach a point in descent which is below the first lowest point of deflection, by a distance which equals four times the statical deflection. Now, by the continuation of this action, the force being supposed to reverse with the motion, each succeeding point of descent will be lower by a fourfold statical deflection, or by $4 \times 0.079 = 0.316$ in. Similarly for the upward movements.

Now, as he wheel makes about five complete turns along the central part of the bridge, we find this fourfold deflection to be repeated five times, giving us a resultant total deflection, due to the cumulative action, of $5 \times 4 \times 0.079 = 1.580$ in., a deflection which is in excess of that due to the whole load of 150,000 lbs, viz.: 1 in., by over 50 per cent. Hence, the cumulative action more than doubles the strain on the bridge. From this it appears that an iron bridge, calculated for the usual statical strain of 10,000 lbs. per square inch, would, from the additional cause now considered, be strained to 25,800 lbs. per square inch, a strain which is fully up to the elastic limit, and hence such a bridge would be in imminent danger of destruction. The individual impulses will vary as the square of the velocity, or speed of the trains, so that, for about 35½ miles per hour, the super-added strains will be only half what they are found for the above case of 50 miles per hour. But one point to be noted is that during a run of 100 or 200 miles, at a stated speed of 30 miles per hour, an occasional speed of 50 may be reached, and this, likely enough, at the critical moment of crossing a bridge.

For freight trains at 15 miles per hour, with 4 ft. drivers, a single impulse is only about one-seventh that for 50 miles, as above. But as the bridges attacked are twice as long, and the number of impulses twice as great, the resultant effect is about one-third that for the 50-mile speed, and hence causes a 35 per cent. superadded strain. This action is believed to be a potent cause in the destruction of bridges, because the drive-wheel system is never exactly balanced. But such vibration is not expected for every train nor every bridge. The reason well authenticated instances of its occurrence are not plenty is probably due to the fact that observing persons are not often in the position to detect it. Cannot the survivors of the St. Charles bridge disaster explain? At least one case occurred in the experience of the writer, causing personal alarm for the second and a half that the engine was apparently jumping along the bridge. It was during a ride in the cab of an engine, while seated and leaning out of the window; the bouncing was decided, and with no mistake, because the ride in this position was taken for the express purpose of seizing upon any peculiar incident or phenomenon. It furnishes a striking corroboration of the above calculations.

CONDITION OF CHICAGO WORKING MEN.

The Chicago *Tribune* gives some interesting extracts from the biennial report of the Secretary of the Illinois Bureau of Labor Statistics. The facts in regard to the condition of working men in Chicago are derived from statements made to the bureau, in reply to interrogatories, by 437 working men, representing 62 different vocations in life, and of a great diversity of condition. Of the whole number reporting, only one-eighth are possessed of homes of their own. A table is presented in the report representing the status of a class of persons who occupy a middle position between the very poor and the more prosperous among the working men, and giving the annual average earnings in each trade or occupation, the number of persons to a family, the number of rooms occupied, and the monthly rental paid. It appears from this table that the average annual income of working men of all occupations in Chicago is $608.70. Two trades show incomes of over $900, five average more than $800, nine average upward of $700, and nineteen upward of $600 per annum. The average family of the working man, as shown in these returns, consists of four persons. The average number of rooms occupied by a family of four is three and one-third. Instances are given in which one room is occupied by a family of six. These are, however, few. In fact, only 6 per cent of all the families reported from are compelled to occupy one room, and about one-half of these are families of two. Twenty per cent. of all the families reported live in two rooms, and one-half of these families have from four to nine members. The average rental paid for three and one-third rooms is $10.25 per month. The greater number of families occupy three or four rooms at a cost of about $3 per room. In order to obtain these tenements at these prices, however, it is necessary to live in the outskirts of the city. This involves the payment of car fare, which increases the rent item about 33 per cent. In this way it is estimated that the laboring man pays about 27 per cent. of his earnings for shelter for himself and his family.

STEAM-ROLLING FOR THE MAINTENANCE OF ROADS IN THE ARDENNES.*

BY M. LANCRENON.

In the southern portion of the department of the Ardennes, and the adjacent districts, the maintenance of the roads is peculiarly troublesome, owing to the high price of suitable material and the chalky soil. The chalk, readily absorbing moisture, is disintegrated, when damp, by the frost, which causes it to swell and become pasty, and the roads formed over it are soon damaged. The only remedies are to keep out the frost by a thick layer of road metal, or to prevent the damp from reaching the chalk by forming an impermeable coating. The first remedy was too costly in most cases, and the partial methods of repair pursued up to 1873, though performed with great care, were too imperfect to secure the second result. A ministerial circular in 1878 having advised the extension of the system of maintenance by spread-

*Abstracted from *Annales des Ponts et Chaussées*, 1882, Vol. III., p. 437, and published in "Abstracts of Papers in Foreign Transactions and Periodicals," Vol. LXIX., Part III., by the Institution of Civil Engineers.

ing layers of metalling across the road and rolling, it was decided to commence this system in 1879. Owing to the unfavorable winter of 1879-80, the work of repair got so behindhand by the autumn of 1880 that at least six rollers, each drawn by eight to eleven horses, whould have been required, with the necessary appendages of water, tools and pumps, at a season of the year when the transport of beet-root and other circumstances raise considerably the cost of hiring horses. A trial of steam-rollers was consequently decided upon. The material to be spread on and rolled in the winter of 1880-81 amounted to 10,700 cubic yards, over a length of 18½ miles. The steam-roller was provided by the person who had the contract for rolling the streets of Paris; it weighed 26 tons. The road metal was laid on and well rolled, and then it was intended to spread thin layers of sand in succession on the top, rolling each layer so as to fill up the interstices. The calcareous sand, however, which had proved satisfactory under ordinary rolling, was crushed between the metalling and the roller; it became pasty, and stuck to the roller, sometimes dragging up the metalling with it. Water was then resorted to for preventing this action, but whenever there was a deficiency of moisture in the sand, owing to fresh portions being crushed as the roller advanced, the adhesion again took place. Next, sand was spread on the consolidated road metal, and the road opened for traffic; but the sand did not settle gradually into place under the wheels of the vehicles as anticipated, and the metal was disturbed by the horses' feet. Metalling alone was then tried, being thoroughly rolled; but the cost was excessive, and a portion of the material was crushed. An attempt to form the road by mixing together the metalling and road scrapings previously to rolling also failed. Drenching the road with water proved successful, but this could rarely be done. Quartzite sand from the Meuse was thought of as a substitute, but the Meuse was in flood, and all the other sand had been delivered. At last the plan of thoroughly consolidating the metalling with the steam-roller short of crushing it, and then, after spreading the full layer of sand over the road rolling it with an ordinary roller, proved successful, and the work was completed in this manner. The detailed financial results of the process are given in a set of tables.

The method of maintenance by spreading layers of metal across a road has the advantage of forming a new regular surface, free from depressions, such as cannot be obtained by patching. Many portions of a road, though very uneven on the surface, have sufficient metal on them to need only a thin, fresh coating; and it is, therefore, generally advisable to reduce the thickness of the layers to a minimum, and increase their length. The amounts adopted after numerous trials were 526 cubic yards per mile for a road 13 feet wide, and 630 cubic yards for a 16½-ft. road. Picking the old surface is the best method of uniting the new and old layers, but it is costly, and, in most cases, picking at the sides, cleaning the old surface and watering when necessary, suffice with heavy rollers. The water is applied after the new layer has been deposited, to prevent its flowing at once into the ditches. The author considers it would be a great improvement to place the water-supply on the roller-carriage, so that the watering might be done by the driver when and where required. The steam-roller consolidates the metalling better than a horse-roller, owing to its weight and its freedom from the disturbance produced by the horses' feet, especially on ascents. In rolling with horse-rollers the stones take longer in settling into their places, and are also more rounded and crushed, as shown by the fact that 2 cubic yards more sand per mile are required with a steam-roller. It was found that nine passages of the steam-roller over the same spot sufficed to consolidate the metalling, and that any further rolling only produced crushing. The steam-roller, weighing 26 tons, costs considerably more to transport from place to place than the ordinary roller, weighing only about 8 tons; but its weight, together with its greater speed, reduce greatly the time occupied in rolling. The cost of rolling with an ordinary roller is reckoned at 18d. per cubic yard of the material; and the actual cost of rolling with the steam-roller amounted to 14.7d., 17.7d., and 18.4d. for the same work. The author, however, considers that the work might be done much more cheaply by purchasing a roller instead of employing a contractor. The yearly cost of the machine is estimated as follows:

Driver	£120
Stoker	80
Pilot	80
Night watchman	20
Fuel	264
Grease, waste, etc	36
Capital charges and repairs	360
	£960

The expenditure on rolling 19,600 cubic yards, the amount of material required for repairing the roads of the department, gives 11.7d. per cubic yard, and adding 1.1d. for supplying the machine with water, the total cost of rolling would be 12.8d. per cubic yard, a much lower price than could be attained by a horse-roller. The author concludes by explaining how the system of steam-rolling could be organized under similar conditions, and he estimates the cost of transforming 1 cubic yard of material into a good road as follows:

	d.
Picking the sides and cleaning the road	1.1
Spreading and application of materials	4.0
Watering	1.5
Feeding the machine (35½ cubic ft. per hour	1.1
Supply of sand	4.4
Application of sand	1.1
Costs of the machine	11.7
	s. d.
	24.9=2 0.9

WHERE DIPHTHERIA OCCURS.

LIKE TYPHOID FEVER, IT IS MORE OF A DISEASE OF THE VILLAGE THAN OF THE CITY.

The mortality statistics collected by the Census Bureau furnish some interesting points with regard to the distribution of certain diseases. The number of deaths during the census year reported as due to diphtheria is, males, 18,849; females, 19,549; total, 38,398; giving a proportion of 51.33 per thousand of all deaths in which the causes are reported. The total number of deaths from diphtheria under one year of age was 2,896; under five years of age it was 20,035; between five and fifteen years of age, 16,162. In the North Atlantic States the proportion of deaths from diphtheria to the total number of deaths having recorded causes was 51.29 per thousand, being in the cities 46.71 per thousand and in the small towns and rural districts, 53.80. In the Gulf Coast States the proportion of deaths from diphtheria was but 12.16 per thousand (13.74 in New Orleans and 12.27 elsewhere), and in the Lake regions it was 81.15. Six cities, from Rochester to Chicago, give an average of 78.15, and the remainder of the region 84.10 per thousand. The statistics of enteric or typhoid fever are equally instructive. The total number of deaths from typhoid fever reported are: Males, 11,852; females, 11,053; total, 22,905, being in the proportion of 31.21 per thousand of all deaths having reported causes. In the North Atlantic States the proportion of deaths from this cause was 16.26 per thousand in the large cities and 19.95 in the country. In New Orleans it was 7.67 and in the rest of the Gulf States 30.03. In the Lake region the deaths from typhoid were 17.16 per thousand in the large cities and 27.31 in the remainder of this region. It will be seen from these figures that neither diphtheria nor enteric fever are especially diseases of the large cities. They appear to be more prevalent in the small towns and rural districts which have no general water supply or systems of sewerage, but obtain their water from springs and wells and observe the usual custom of storing excreta in cesspools or vaults.

THEIR FIRST APPEARANCE.

Envelopes were first used in 1839.

Anæsthesia was discovered in 1844.

The first steel pen was made in 1830.

The first air pump was made in 1654.

The first lucifer match was made in 1798.

Mohammed was born at Mecca about 570.

The first iron steamship was built in 1830.

The first balloon ascent was made in 1798.

Coaches were first used in England in 1569.

The first steel plate was discovered in 1830.

The first horse railroad was built in 1826-27.

The Franciscans arrived in England in 1224.

The first steamboat plied the Hudson in 1807.

The entire Hebrew Bible was printed in 1488.

Ships were first "copper bottomed" in 1783.

Gold was first discovered in California in 1848.

The first telescope was used in England in 1608.

Christianity was introduced into Japan in 1594.

The first watches were made at Nurenburg in 1477.

First saw maker's anvil brought to America in 1819.

First almanac printed by Geo. Von Furbach in 1460.

The first newspaper advertisement appeared in 1652.

Percussion arms were used in the U. S. Army in 1830.

The first use of a locomotive in this country was in 1829.

Omnibuses were first introduced in New York in 1830.

Kerosene was first used for lighting purposes in 1826.

The first copper cent was coined in New Haven in 1687.

The first glass factory in the United States was built in 1780.

The first printing press in the United States was worked in 1620.

Glass windows were first introduced into England in the eighth century.

The first steam engine on this continent was brought from England in 1753.

The first complete sewing machine was patented by Elias Howe, Jr., in 1846.

The first Society for the Promotion of Christian knowledge was organized in 1698.

The first attempt to manufacture pins in this country was made soon after the war of 1812.

The first prayer book of Edward VI. came into use by authority of Parliament on Whitsunday, 1549.

The first temperance society in this country was organized in Saratoga County, N. Y., in March, 1808.

The first coach in Scotland was brought thither in 1561, when Queen Mary came from France. It belonged to Alexander Lord Seaton.

The first daily newspaper appeared in 1702. The first newspaper printed in the United States was published in Boston on Sept. 25, 1790.

The manufacture of porcelain was introduced into the province of Hezin, Japan, from China in 1513, and Hezin ware still bears Chinese marks.

The first society for the exclusive purpose of circulating the Bible was organized in 1805, under the name of the British and Foreign Bible Society.

The first telegraphic instrument was successfully operated by S. F. B. Morse, the inventor, in 1835, though its utility was not demonstrated to the world until 1842.

The first Union flag was unfurled on Jan. 1, 1776, over the camp at Cambridge. It had thirteen stripes of white and red, and retained the English cross in one corner.

When Capt. Cook first visited Tahiti, the natives were using nails of wood, bone, shell, and stone. When they saw iron nails they fancied them to be shoots of some very hard wood, and, desirous of securing such a valuable commodity they planted them in their gardens.—*N. Y. Sun.*

NOTES.

GOVERNMENT RAILROADS IN GERMANY.

Consul General Vogeler has made an interesting report to our Government on the results of the Government control of railroads in Germany. The principle of State influence in the management of railroads was applied in the early days of railroad construction. In 1838, a Prussian law imposed a sinking fund tax on railroads, with a view to paying off the capital employed, in order that the roads might after that be run at the cost service, and it was provided further that, at the expiration of a certain time, the State should have the privilege of buying the roads. In 1843 Prussia began to subsidize and build railroads, and from 1849 to 1859 taxes were imposed to buy up railroads, as a part of the systematic policy of the Government. In 1873 a Government commission reported that it was desirable to transfer to the empire the general supervision of German railroads and to regulate them by imperial laws and tribunals. In 1876 Prussia offered to make over all her railroads to the Imperial Government, but the smaller States were alarmed at this, and some of them anticipated the Imperial Government by buying up the roads in their own territory. Public opinion, according to Mr. Vogeler, has grown more favorable to State ownership. In Prussia, more than four-fifths of all the lines are owned or operated by the State. The receipts of the State roads increased 3.6 per cent. in 1880-81, and the expenditures only 1.9 per cent. The gross profits in 1879-80 were about $38,000,000, and in 1880-81 about $40,000,000, the latter sum representing an annual return of 5 per cent. on the capital which Prussia has invested in her railways. Adding to these railways the lines in the provinces of Alsace-Lorraine, it appears that more than one half of all the lines in the empire are virtually under imperial control. On the Prussian State railroads, 112,446 men are employed, who constitute a pretty solid voting force for the Government.

GIANT POWDER PATENT SUIT.

PITTSBURGH, Dec. 20.—An important suit has been entered in the United States District Court by the Atlantic Giant Powder Company of California, against Marcus Hulings of this city. It is a suit in equity for infringements of patents held by the complainant company covering certain processes employed in the manufacture of nitroglycerine, giant powder and almost all other explosives. If the patents are held to be valid it will give the complainant almost a monopoly of the manufacture of explosives in the United States, which will be far more valuable than the Roberts torpedo patent. Counsel for the defendants moved to dismiss the bill, which motion was overruled, and sixty days' time was granted to file their answer. The same company also brings action in

equity for infringements of the same patents against Wilson & Barr, Boland & Barr, and J. G. Howe *et al.*

DRIVEN WELLS DECISION.

WASHINGTON, Dec. 20.—Judgment has been rendered by the United States Supreme Court in the case of Wahl against Hine, sustaining the validity of the patent known as Green's driven well patent, and the right of the patentee and his assignees to collect royalties from the users of the wells. There are many of these wells in use, and there are several hundreds of cases pending in the circuit courts throughout the country for royalties, which will also be determined by this decision of the Supreme Court.

A MEMORABLE year in the history of artillery science has ended with some conclusive experiments at Spezia. The new steel and compound armor plates are shown to be able to withstand any known projectile, even the 2,000-pound Whitworth steel shot from the new 100-ton gun. Artillerists abandon the idea of perforating the armor of the future, and will now turn their attention to the construction of larger guns and the use of enormous projectiles, so as to gain the greatest possible total energy of blow. Hereafter the effort will not be to perforate a ship's armor, but to crush in her whole side by the impact of a projectile, weighing two or three tons, and having a striking velocity of 1,500 ft. per second, and a total energy of about 100,000 ft. tons. With such ordnance it becomes not so much a question of the vessel's exterior armor as of her structural strength. The 100-ton breech-loader used is 39 ft. long, 17 in. bore, takes 700 pounds of powder at a charge, carries a shot weighing a ton, and can be loaded, aimed and discharged by the hand of a lady in less than one minute, so simple is the machinery by which it is operated. It was powerless, however, against the new steel and compound armor.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

CHICAGO WATER-WORKS.—Up to the 1st of January there will be in use about 514 miles of water-pipe, something less than 20 miles having been laid this year, at a cost of nearly $200,000, including hydrants, stop-cocks, etc. The quantity of water supplied during the year will amount to about 25,000,000,000 gallons, or an average of nearly 70,000,000 gallons per day. There have been nearly 6,000 service pipes attached during the year, about 70 elevators put in, and 225 water-meters. The remainder of the superstructure of the lake crib has been built, two new pumping engines for the West Side pumping works are well under way, and the foundations in course of construction. The cost of the engines, foundations and buildings will be close to $400,000.

THE Equitable Gas Light Company, of this city, has been chartered by the commission. The company agrees to furnish gas to the public at $1.75 per 1,000 cubic feet, and to pay the city 20 cents for each lineal foot of mains laid. The street lamps are to be lighted for $12 each a year. The rates of the new company will be much lower than those charged by the old companies.

NEW WATER-WORKS.—WICHITA, Kan., Dec. 22.—St. Louis capital is building a complete system of water-works in this city.

THE Hartford, Conn., Gas Company has voted to reduce the price of gas 5 per cent.—from $2 to $1.90 per thousand ft.—the reduction to date back from Dec. 1. For the city lamps they reduce from $1.90 to $1.80.

AN UNTAMED PUMP ON THE RAMPAGE.—A man erected some kind of new fangled pumping apparatus for a rancher at Paradise Valley. The pumping machine was to be driven by wind. The other day when a ten-knot breeze was blowing the inventor "turned her loose." In about hlaf an hour the machine flooded the cattle corral with water and floated away the butt end of a haystack. The ranchman yelled to his machinist: "Stop her! stop her!" but it happened that provision for stopping was what the inventor had not thought of. Had it not been that the well was soon pumped dry the whole ranch would probably have been washed away. Even after the well was dry the machine threw mud and gravel so wickedly that to approach it was unsafe. —*Territorial Enterprise.*

ELECTRICITY.

ELECTRIC lights are to be placed in all the rooms on the main floor of the new capitol at Albany. Among the rooms which will be thus lighted are the Governor's apartments, the Secretary of State's and the Attorney-General's. No attempt will be made to light the large halls used by the legislature with the electric lamps, a previous trial of them having shown that they do not give a steady enough light for the members to write with ease at the night sessions. It is probable that the stone ceiling of the assembly chamber will be sufficiently repaired to permit of the room being used by the assembly when that body meets on Jan. 2.

THE ELECTRIC LIGHT AND THE FOG.—During the recent extraordinary fog the Edison Electric Light Company, recognizing the necessity for distributing the light to their customers without intermission, maintained their dynamos in action at Holborn Viaduct for a continuous period of 64 hours without stopping. Starting at 3 o'clock on Saturday afternoon, December 9, the dynamos ran without ceasing during Saturday, Sunday, Monday, and Monday night, stopping at eight o'clock on Tuesday morning, December 12. This had not previously been done in England, and was not accomplished by the other electric light companies in the city. The current was supplied from two large dynamos which are used alternately, and during this long run the current was switched off from one dynamo on to the other, or back again, five times by means of a peculiar switch, which enables this to be done without in the least degree interrupting the lighting. The incandescent lamps in the shops on Holborn Viaduct and in the street were thus maintained during the whole of this time.—*London Ironmonger.*

THE LIGHTING OF HELL GATE.—Mr. A. A. Hayes and Mr. Brush, of the Brush Electric Light Company, are at present in Washington in consultation with the Lighthouse Board on the subject of illuminating Hell Gate by electricity by the Brush system. The Brush Electric Light Company recently submitted to the Lighthouse Board a model of an iron tower, of skeleton design and in shape an obelisk, with a glass cupola cap on top to protect the light, approached by an elevator ascending the center of the tower. This design was rejected by the Lighthouse Board, who objected to the use of tubular iron which was necessary to the plan, and Messrs. Hayes and Brush will obtain instructions from the Lighthouse Board.

STREETS, DRAINAGE, ETC.

SOME contractors were in Council Bluffs, Iowa, the other day looking after a chance to pave Main street and Broadway with a macadam of Sioux Falls granite. They propose to put on six inches of limestone macadamized, and on top of this six inches of the granite, and say the cost will be about $2.25 a yard.

CANALS.

THE FLORIDA CANAL.—The dredge of the Okeechobee Drainage Company, working up the Caloosahatchee River, entered Lake Okeechobee on the 20th inst. This opens a navigable channel from the heart of the Everglades to the Gulf of Mexico, an important event in the history of Florida, as it opens up extremely rich sugar lands.

RAILROADS.

WINTER WORK ON THE NORTHERN PACIFIC.—The advance of winter in no perceptible degree serves to check railroad building in Montana. The Northern Pacific continues in the field with large forces of men, and grading and track-laying are going ahead east and west on the converging ends. Strong bodies of graders are assaulting the Belt Range, west of the Yellowstone, and every hour of the 24 is utilized in pushing the work over the divide. Huge fires blaze on the mountain sides, lighting up the busy scene of operations at night time, and pick and shovel, blast and barrow, are kept employed by gangs of scores and hundreds without a moment's stop or intermission. The steel-railed track, parting from the Yellowstone, which it has followed in one unbroken stretch of 300 miles, is now surmounting the most formidable barrier on the line of the road, and in a fortnight, or three weeks at most, will have reached the Valley of the Gallatin and sighted the Three Forks of the Missouri. Every effort is being put forth to finish up the several cuts and fills on the range, toward which the track-layers are marching at the rate of a mile a day. By New Year's day the whistle of the locomotive will be within hearing distance of Bozeman, and before the first month of 1883 is gone construction trains will be landing rails and other building material at and west of that point. November and December have been exceptionally moderate, and should the weather continue as favorable as experienced thus far, we may expect a completed track to Gallatin in February and to Helena by June. From the West, with progress continued as now, Missoula will be reached by March and the western side of the Main Range before the end of June. It is perhaps possible to make the continental connection by July 4, but the meeting of the two ends we place at a little later day, and the place which will witness the important event will likely enough be the summit of the Rocky Mountains, 15 miles west of Helena.—*Helena (Mont.) Herald.*

A NOTE from Albany, Ga., states that the president of the Brunswick & Albany railroad has ordered the construction of the line into Albany and towards Montgomery.

Two thousand men and 1,000 horses are now employed on the Ontario and Quebec, between Toronto and Montreal. One-third of the road, which will be about 300 miles long, is now graded. Tenders for rails will soon be invited, and it is expected by this time next year through trains will be running.

THE extension of the Chicago and West Michigan railway to the mouth of Muskegon lake is being pushed forward rapidly and the track has been laid partly along the beach of Lake Michigan.

IT is stated that the work of completing the double track on the Grand Trunk between Toronto and Montreal, will be commenced in the Spring.

THE UNITED STATES CABLE RAILWAY company of Chicago has been incorporated; capital, $1,000,000.

STREET RAILWAY STATISTICS.—At a meeting held in Boston, Dec. 12, for the purpose of organizing a National Street Railway Association, Mr. Moody Merrill, of Boston, delivered an address, in which he said: "There are now organized and doing business in this country and Canada 415 street railways. These companies employ about 35,000 men and run 18,000 cars. More than 100,000 horses are in daily use to feed which it requires annually 150,000 tons of hay and 11,000,000 bushels of grain. These companies own and operate over 3,000 miles of track. The whole number of passengers carried annually is over 1,212,400,000. The amount of capital invested in these railways exceeds $150,000,000."

THE N. P. C. RAILROAD.—From the Marin County *Journal*, of San Rafael, Cal., of Dec. 14, we clip the following: "The North Pacific Coast Railroad Extension Company is not letting the grass grow under its feet. The company is about letting contracts for the construction of its new line from Corte Madera Station to Saucelito, which includes much heavy work and a tunnel 2,100 ft. long. The specifications order that the work be completed by Sept. 1, 1883. The portions not contracted for will be built by the company, and the total estimated cost of the work will reach as high as $150,000. The new line will consist of light grades and easy curvature, and materially shorten the distance between San Rafael and San Francisco. Mr. George M. Dodge has been appointed Constructing Engineer, and is now busy getting the line ready for the graders."

RAILROAD STATISTICS FOR 1882.—The *Railway Age* of Chicago publishes a table showing that the number of miles of main track laid during the year of 1882 was 10,821, on 316 lines, in forty-four states and territories. Full returns will probably make the grand total 11,000 miles, which is 1,500 miles more than was constructed in 1881—the banner railroad building year up to that time. The number of miles constructed in the states mentioned below is as follows: Iowa, 953; Texas, 817; New York, 752; Ohio, 555; Arkansas, 529; Indiana, 529; Colorado, 500; Dakota Territory, 480; Pennsylvania, 464; and Minnesota, 444. Of the 316 roads noted, 140 are still uncompleted. The capital invested during the year is estimated at $270,000,000, exclusive of the amounts expended in the preparation of the road-beds on which tracks are not yet laid.

TROY, N. Y., December 28.—A survey has been completed for a railroad from Valatie, Columbia County, to the Hudson River, a distance of about five miles, connecting with the Hudson River Railroad.

CONTRACTS LET.

THE Manly & Cooper Manufacturing Company, Elm avenue and Forty-second street, Pittsburgh, have secured the contract for the fire-proof shutters of the new United States Custom House and Post Office, Cincinnati, at $124,666.65.

BUILDING.

VERMONT is said to produce more marble than any other state in the union or than any country except this. The business has expanded with marvelous rapidity since 1870, when comparative little Vermont marble was to be found in the market. The aggregate amount of the state's production the present year is 1,000,000 cubic feet, valued at over $2,000,000. The number of men employed in the quarries and mills exceeds 2,300, and it required 10,000 cars to carry the marble away. Nearly $1,000,000 was paid for the labor of workingmen by the quarry owners.

BUILDING OPERATIONS IN CHICAGO.—The building operations during the past year were never exceeded, except in 1872, the year succeeding the great fire. Even then the amount of rebuilding was only twice as great as that of the past year, and the amount of ground covered by structures was less than twice as great. Building permits to the number of 5,630 have been issued; the frontage of new structures, lineal measure, is fourteen miles, and the cost of buildings erected on permits, $17,500,000. The total cost probably amounts to $20,000,000. Suburban towns show an equal growth and building prosperity, and the character of the edifices is generally improved.

THE Bowling Green Building Company, of the city of New York, has been incorporated. Capital, $1,000,000. The object is to erect buildings in the city.

A GLASS spire is to be a feature of a new Presbyterian church in Philadelphia.

TRUSS BRIDGES.*

AN ILLUSTRATED HISTORICAL DESCRIPTION OF ALL EXPIRED PATENTS ON TRUSS BRIDGES, WHICH UNDER THE LAW ARE NOW PUBLIC PROPERTY AND FREE TO BE USED BY ANY ONE.

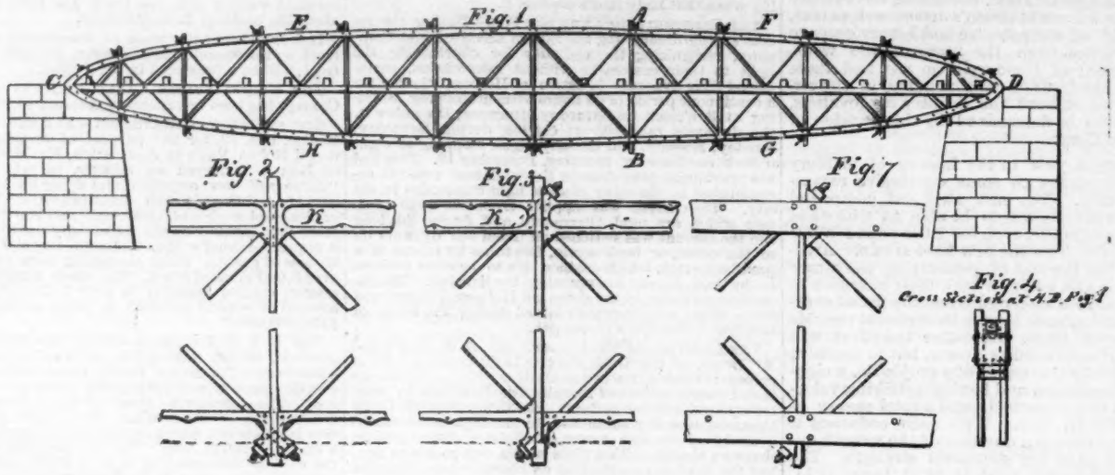
By F. B. Brock, Patent Attorney, Washington, D. C.

March 27, 1849, James Barnes, of Massachusetts, devised a truss bridge in which he united the two chords, the upper and lower, of an ordinary truss into one elliptical or oval curve, in which the tension of the lower portion of the curve, being transmitted along the curve to the upper portion is resisted by the opposing thrust of the latter.

Fig. 1 exhibits the form of the truss *C D E F G H* as constructed of iron. The elliptical curve is formed of parallel plates. Straining beams *K* of cast-iron are interposed between the parallel plates, and extend from post to post.

* Copyright, 1882.

The ends of the straining beams, where they abut against the post, are enlarged in order to form shoulders for the purpose of receiving the ends of diagonal cast-iron braces. The sustaining rods which form the interior frame work of the truss, are of wrought iron. By this mode of bracing the curved or elliptical form of the truss is preserved, and the several tensions and thrusts of the structure are properly transmitted.



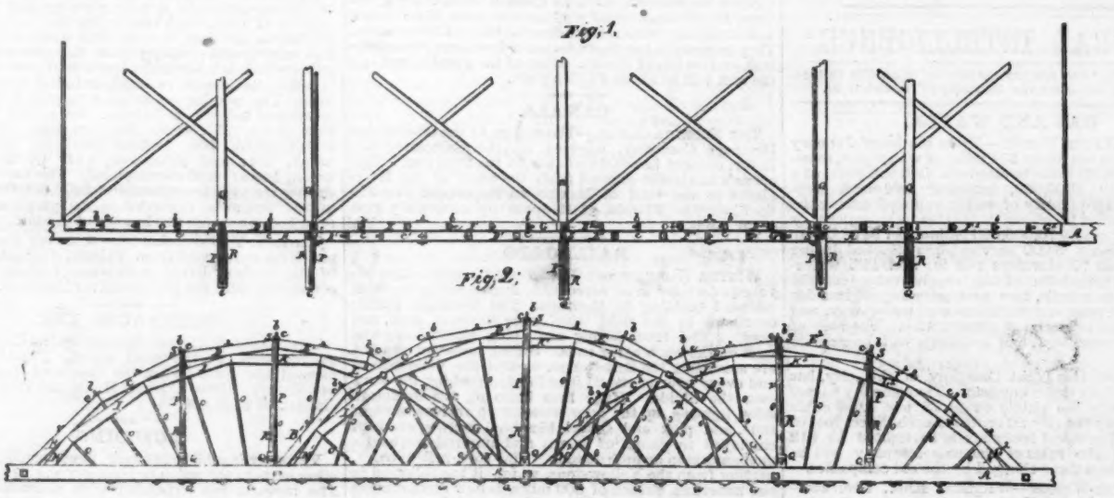
BARNES' BRIDGE.

It would seem that Barnes' construction is the first to provide a continuous curved chord, by means of which the thrusts and tensions are continued throughout the chord and made reciprocal.

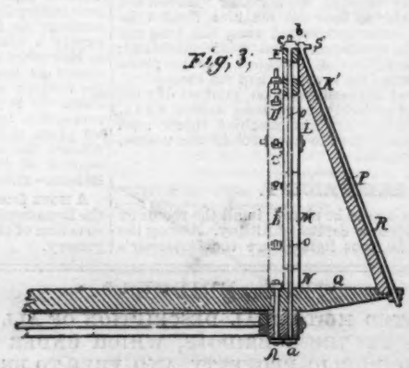
April 23, 1850, Henry Lanergan, of Massachusetts, devised a novel truss bridge.

A is the main chord, *B* B^1 and B^2, etc., are separate series of straight timbers disposed together in a curve resting on the chord *A*. Under these timbers another series *H* H^1 H^2, etc., are arranged as seen in the drawings.

The several timbers of each arc are arranged in chords of the curve of the same, making a very obtuse angle with each other. Through their angle of junction, and the middle of the timber which lies directly above or below them, one of a series of suspension rods *o* is carried in a radial direction. These rods have heads *a*, screws *b*, and nuts *c*. Correction may be made for any sagging or settlement of the timbers by means of these suspension rods. Each arch is made to lap or extend by the one on one or both sides of it, or so that one or both of its feet shall rest upon the chord. The suspension rods of nearly half of one arch are made to cross those of nearly half of another arch and to act in connection with them to support the chord *A*, thus ensuring to the beam a compensation for the thrust of the two arches. The thrust of one arch being in a direction opposite to that of the other causes the resultant or force sustaining the beam to operate in nearly a vertical direction. Each arch may be supported by one or more inclined timber struts *P* extending down from it and resting on a timber *Q*, bolted transversely upon and to the timber *A*. A tension rod *R* is also used, which passes through the timber *Q*, and downward from a metallic lap plate *S* on the top of the arch.



LANERGAN'S BRIDGE.



LANERGAN'S BRIDGE.

(TO BE CONTINUED.)